PE TITLE: Aerospace Propulsion

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

February 1999

BUDGET ACTIVITY

PE NUMBER AND TITLE

2 - Applied Research

0602203F Aerospace Propulsion

I'll					•					
COST (\$ In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	58,054	68,329	62,012	66,607	70,453	74,783	71,197	72,225	Continuing	Continuing
3012 Advanced Propulsion Technology	1,683	1,941	0	0	0	0	0	0	0	0
3048 Fuels and Lubrication	10,629	11,569	8,415	9,036	9,392	14,181	14,629	15,037	Continuing	Continuing
3066 Turbine Engine Technology	31,682	36,078	41,421	42,055	39,867	36,710	32,179	32,396	Continuing	Continuing
3145 Aerospace Power Technology	14,060	18,741	12,176	15,516	21,194	23,892	24,389	24,792	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: As of FY 2000, all high-speed propulsion efforts under Project 3012, Advanced Propulsion Technology, are terminated. The decrease in Project 3048, Fuels and Lubrication, beginning in FY 2000 reflects deemphasis on high thermal stability fuels and engine technologies. The decrease in Project 3066, Turbine Engine Technology, beginning in FY 2002 reflects deemphasis on turbine engine technologies. The increase in Project 3145, Aerospace Power Technology, beginning in FY 2003 reflects increased emphasis on power components for space applications.

- (U) A. Mission Description: This Applied Research program develops airbreathing propulsion and aerospace power technologies. The prime areas of focus are turbine engines, dual-mode ramjets, combined cycle engines, fuels, lubricants, and aerospace power technologies. Technology advances in turbine engine propulsion and lubrication systems are part of the Integrated High Performance Turbine Engine Technology (IHPTET) program and will increase engine performance, increase reliability, reduce specific fuel consumption, and lower cost of ownership. Dual-mode ramjet and combined cycle engines will increase weapon lethality and effectiveness against time-critical targets via high-speed propulsion systems. Fuels efforts will reduce system cost, maintenance, and the usage of hazardous cleaning materials while increasing aircraft performance and life through development of thermally stable and high heat sink fuels. High heat sink fuels from coal-derived resources will be investigated. Power system technologies are focused to eliminate troublesome, centralized hydraulic systems by replacement with highly reliable electric systems. Power conditioning, thermal management, and power source improvements will significantly enhance reliability, reduce weight, and lower life cycle costs.
- (U) **B.** <u>Budget Activity Justification</u>: This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

Page 1 of 12 Pages

Exhibit R-2 (PE 0602203F)

JDGET ACTIVITY		PE NUMBER AN	ID TITLE		
- Applied Research		Aerospace			
U) C. Program Change Summary (\$ in Thousands):					
					Total
	FY 1998	FY 1999	FY 2000	FY 2001	<u>Cost</u>
J) Previous President's Budget/FY 1999 PB	57,261	69,061	70,539	73,303	Cont
U) Appropriated Value	60,577	69,561			
U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-2,389	-1,232			
b. SBIR	-964				
c. Omnibus/Other Above Threshold Reprogrammings	-756				
d. Below Threshold Reprogrammings	1,586				
U) Adjustments to Budget Year Since FY 1999 PB			-8,527	-6,696	
	50.054	(0.000	(0.010	(((07	Cont
 (U) Current Budget Submit/FY 2000 PB (U) Significant Program Changes: Changes to this program (S&T) Program. As of FY 2000, all high-speed propulsion 					within the Science and Technol
U) (U) Significant Program Changes: Changes to this program	m since the prev	ious President's l	Budget are due to	o higher priorities	within the Science and Technol
U) (U) Significant Program Changes: Changes to this program (S&T) Program. As of FY 2000, all high-speed propulsion	m since the prev	ious President's l	Budget are due to	o higher priorities	within the Science and Technol
U) (U) Significant Program Changes: Changes to this program (S&T) Program. As of FY 2000, all high-speed propulsion	m since the prev	ious President's l	Budget are due to	o higher priorities	within the Science and Technol
U) (U) Significant Program Changes: Changes to this program (S&T) Program. As of FY 2000, all high-speed propulsion	m since the prev	ious President's l	Budget are due to	o higher priorities	within the Science and Technol
U) (U) Significant Program Changes: Changes to this program (S&T) Program. As of FY 2000, all high-speed propulsion	m since the prev	ious President's l	Budget are due to	o higher priorities	within the Science and Technol
U) (U) Significant Program Changes: Changes to this program (S&T) Program. As of FY 2000, all high-speed propulsion	m since the prev	ious President's l	Budget are due to	o higher priorities	within the Science and Technol
U) (U) Significant Program Changes: Changes to this program (S&T) Program. As of FY 2000, all high-speed propulsion	m since the prev	ious President's l	Budget are due to	o higher priorities	within the Science and Technol
U) (U) Significant Program Changes: Changes to this program (S&T) Program. As of FY 2000, all high-speed propulsion	m since the prev	ious President's l	Budget are due to	o higher priorities	within the Science and Technol
U) (U) Significant Program Changes: Changes to this program (S&T) Program. As of FY 2000, all high-speed propulsion	m since the prev	ious President's l	Budget are due to	o higher priorities	within the Science and Technol
U) (U) Significant Program Changes: Changes to this program (S&T) Program. As of FY 2000, all high-speed propulsion	m since the prev	ious President's l	Budget are due to	o higher priorities	within the Science and Technol
U) (U) Significant Program Changes: Changes to this program (S&T) Program. As of FY 2000, all high-speed propulsion	m since the prev	ious President's l	Budget are due to	o higher priorities	within the Science and Technol
U) (U) Significant Program Changes: Changes to this program (S&T) Program. As of FY 2000, all high-speed propulsion	m since the prev	ious President's l	Budget are due to	o higher priorities	within the Science and Technol

Page 2 of 12 Pages

Exhibit R-2 (PE 0602203F)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)									DATE Fe	February 1999		
BUDGET ACTIVITY 2 - Applied Research		10MBER AND 02203F		PROJECT 3012								
COST (\$ In Th	nousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost	
3012 Advanced Propulsion Techno	ulsion Technology 1,683 1,941 0 0 0 0 0									0		
ta (n - (U) \$343 In hy - (U) \$708 In square - (U) \$1,683 To (U) FY 1999 (\$ in Thouse - (U) \$712 In ta (n - (U) \$712 In ta (n - (U) \$378 In - (U) \$388 In -	ands): nvestigated unique coarget loiter for high-spanned and unmanned avestigated, develope ypersonic missiles and uvestigated unique pupeed aerospace vehichmanned) and airbrestotal	oncepts for copeed aerospations and exploit athing boost and airband exploits. This effects are arrows and exploits are arrows and exploit I les to provide les. This effects are thing boost and exploit I les to provide les. This effect is eathing boost arching boost a	ombining adace vehicles reathing boo oited Russian es to provide on engine cofort supports eers. ombining adace vehicles reathing boo Russian hype e greater ran on engine cofort supports	dvanced proposters. In hypersonic greater ran oncepts to particularly technology and the proposters. In hypersonic greater ran oncepts to particularly technology and the proposters. It is effort the proposter of the particular the proposter of the proposition of the proposi	pulsion cycle t supports te c technology age and incre rovide the ca y transition fe pulsion cycle rt supports te nology. This reased veloci rovide the ca	es which prochnology tra This effort ased velocity apability for or next general section of the	vide the cap- nsition for n supports tec which enha takeoff, acce- ration reconn ride the capa nsition for n orts technolo- nance weapo akeoff, acce-	ability for taken the chnology transition to take the chnology transition to take the characteristic transition of the characteristi	keoff, acceleration for none effectiveneral seeds, and targrike vehicles decorrection for next goess.	eration, cruisessance/strike ext generationss. get loiter for (manned an an aration, cruisessance/strike) eneration hypet loiter for hypet loi	e, and vehicles on high- d e, and vehicles personic	
Project 3012				Page 3 of	f 12 Pages			Exhibi	t R-2A (PE	0602203F)		

RDT&E BUDGET ITEM JUSTIFICATION	SHEET (R-2A Exhibit)	February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 3012
(U) FY 2000: Not Applicable.		
(U) FY 2001: Not Applicable.		
(U) B. <u>Project Change Summary - Description of Significant Changes</u> : Chan within the Science and Technology (S&T) Program.	ges to this project since the previous President's l	Budget are due to higher priorities
(U) C. Other Program Funding Summary:		
 (U) Related Activities: (U) PE 0603216F, Aerospace Propulsion and Power Technology. (U) Program is reported to/coordinated by the Joint Army/Navy/NASA/A (U) This project has been coordinated through the Reliance process to h 		
(U) D. Acquisition Strategy: Not Applicable.		
(U) E. Schedule Profile: Not Applicable.		
Project 3012 Page	e 4 of 12 Pages E	xhibit R-2A (PE 0602203F)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)										DATE February 1999			
BUDGET ACTIVITY 2 - Applied Research	BUDGET ACTIVITY 2 - Applied Research					PE NUMBER AND TITLE 0602203F Aerospace Propulsion					ргојест 3048		
COST (\$	In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost		
3048 Fuels and Lubrication	10,629 11,569 8,415 9,036 9,392 14,181							14,629	15,037	Continuing	Continuing		
(U) A. Mission Description and alternate fuels are development to temperatures. (U) FY 1998 (\$ in T) - (U) \$6,136 - (U) \$1,793 - (U) \$2,700 - (U) \$10,629 (U) FY 1999 (\$ in Th - (U) \$4,227 - (U) \$2,484 - (U) \$4,633	nousands): Developed high therm systems. This techno loads, higher engine to Developed high perform with developing high weight ratio and lowed Developed lubricant to conventional and advision magnetic levitation are conventional approact Total	Air Force aer mal stability I logy is for cu emperatures rmance, low performance specific fuel echnology to anced lubrica and solid and hes. I stability hyd logy is for cu emperatures nance, low en performance specific fuel hnology to p nts, and mec	rospace apply anydrocarbon arrent and fur, and reduce emissions, and manufactured and fur and reduce missions, role, low maint consumptions, low maint consumptions ermit efficients and systematical sy	a fuels to pro- nature aircrafted fuel constructions. For a fuel construction of the c	ovide higher it to reduce for umption. Dustor conceptions that ope peed rotation extens extendivanced enginest to reduce for umption. Stor concepts ines that ope eed rotation oped to their hi	heat capacity and tapacity and capacity and capacity and systems for advance at capacity and systems for advance arate efficient for advance and capacity and systems for advance arate efficient for advance and systems for	y and operate outling/coking the thermally within airengine comparing conditions of the training conditions of turbine entity within airengine comportative limital	r stable, cost ing temperating, and providengines to reactions that experiments and providence of the control of the cost of t	tures for aircraide cooling feduce the risk acceed the cap res for aircraide cooling f	raft and missor increased and cost as d have high includes pproaches, sabilities of the and missill or increased and cost assort dhave high cludes convectudes con	thigher sile avionics ssociated thrust-to- such as e avionics ciated thrust-to- entional etic		
- (U) \$225	approaches. Identified as a source	for SBIR.											
Project 3048				Page 5 of	12 Pages			Exhibi	t R-2A (PE	0602203F)			

RD	T&E BUDGET ITEM JU	STIFICATION SHEET (R-2A Exhib	oit) Pebruary 1999
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
2 - Applied Rese		0602203F Aerospace	Propulsion 3048
- (U) \$11,569	Total		
(U) <u>FY 2000</u> (\$ in	Thousands):		
- (U) \$2,993	aerospace systems. This techn	hydrocarbon fuels to provide higher heat capacity, high plogy is for current and future aircraft to reduce fuel system r engine temperatures, and reduced fuel consumption.	
- (U) \$2,000	Develop high performance, low associated with developing high	v emissions, robust combustor concepts for advanced aid h performance, low maintenance engines that operate e	
- (U) \$3,422	and advanced lubricants, and r	o permit efficient high-speed rotation of turbine engine nechanical systems extended to their highest temperatu ubrication for advanced engines with operating conditi	are limitations and approaches, such as magnetic
- (U) \$8,415	**		
(U) FY 2001 (\$ in	Thousands):		
- (U) \$3,138	Develop high thermal stability aerospace systems. This techn	hydrocarbon fuels to provide higher heat capacity, high plogy is for current and future aircraft to reduce fuel systems, and reduced fuel consumption.	
- (U) \$2,200	Develop high performance, lov	v emissions, robust combustor concepts for advanced aid h performance, low maintenance engines that operate e	
- (U) \$3,698	Develop lubricant technology tand advanced lubricants, and r	o permit efficient high-speed rotation of turbine engine nechanical systems extended to their highest temperatu ubrication for advanced engines with operating conditi	are limitations and approaches, such as magnetic
- (U) \$9,036			
Project 3048		Page 6 of 12 Pages	Exhibit R-2A (PE 0602203F)

RDT&E BUDGET ITEM JUSTIFICATION	DATE February 1999	
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 3048
(U) B. Project Change Summary - Description of Significant Changes: Change within the Science and Technology (S&T) Program.	ges to this project since the previous President's Buc	lget are due to higher priorities
(U) C. Other Program Funding Summary:		
 (U) Related Activities: (U) PE 0603216F, Aerospace Propulsion and Power Technology. (U) This project has been coordinated through the Reliance process to have 	armonize efforts and eliminate duplication.	
(U) D. Acquisition Strategy: Not Applicable.		
(U) E. Schedule Profile: Not Applicable.		
Project 3048 Page	27 of 12 Pages Exhi	bit R-2A (PE 0602203F)

	Develops technology to ost of ownership. An exhaust systems, and	alytical and	d experimen	FY 2000 Estimate 41,421 system opera		FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate		ROJECT 3066 Total Cost			
O66 Turbine Engine Technology U) A. Mission Description: I eight, fuel consumption, and coternal flow systems, controls, of HPTET) program. (U) FY 1998 (\$ in Thousa - (U) \$28,632 Description Des	Develops technology to ost of ownership. An exhaust systems, and	Actual 31,682 to increase allytical and	26,078 propulsion so	Estimate 41,421 system opera	Estimate 42,055 ational reliab	Estimate 39,867	Estimate	Estimate			Total Cost			
U) A. Mission Description: It eight, fuel consumption, and conternal flow systems, controls, of HPTET) program. (U) FY 1998 (\$ in Thousa - (U) \$28,632 Description:	ost of ownership. An exhaust systems, and	to increase	propulsion s	system opera	ational reliab	,	36,710	22.470			Total Cost			
eight, fuel consumption, and conternal flow systems, controls, of HPTET) program. (U) FY 1998 (\$ in Thousa - (U) \$28,632 Do	ost of ownership. An exhaust systems, and	alytical and	d experimen				ology 31,682 36,078 41,421 42,055 39,867 36,710 32,179 32,39							
- (U) \$3,050 Do turpe - (U) \$31,682 To (U) FY 1999 (\$ in Thousa - (U) \$24,810 Do pr - (U) \$5,875 Do turpe - (U) \$2,415 Do en	eveloped core engine ill provide aircraft en eveloped turbine engi rbofan/turbojet engin erformance, increased otal	gines with line compones for figh durability, omponents a with higher component es for figh durability, or expendatost, reduced	higher performents (fans, laters, attack a reduced fue for turbofanter performants (fans, low ters, attack a reduced fue ble engines and fuel consumer fuel consumer performents (fans, low ters, attack a reduced fuel consumer fuel consumer fuel fuel consumer fans fans fans fans fans fans fans fans	Can/turbojet ormance, inclow pressure aircraft, bonel consumption, increase we pressure the aircraft, bonel consumptifor missile a mption, and	engines for fi reased durable turbines, en abers, and tra- tion, and lower gines for fighted durability, arbines, enginabers, and tra- tion, and lower and unmanned increased sp	ghters, attace ility, reduce gine control ansports. The relife cycle of the controls, ansports. The reduced fuene controls, ansports. The relife cycle of air vehicle pecific thrust	k aircraft, bod fuel consus, exhaust no ese components. aircraft, bomel consumptiex haust nozzese components. applications, greatly exp	ombers, and mption, and ozzles, and intents will produce the control of the contr	transport. To lower life cyntegration technology. The properties and the properties of the properties	chese comported cost. chnology) for engines with the cost. chnology) for engines with the cost. chology for engines with the cost cost. chology for engines with the cost cost.	or h higher ents will h higher pendable uise			
– (U) \$701 Id	ansports. entified as a source fo otal	or SBIR.			·									

DGET ACTIVITY - Applied Researd		ATION SHEET (R-2A Exhibit)	February 1999	
- Applied Meseald	h	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 3066	
(U) FY 2000 (\$ in Th	ousands):			
- (U) \$29,386	Develop core engine components for turbo	ofan/turbojet engines for fighters, attack aircraft, bombers, and to		
- (U) \$6,958	Develop turbine engine components (fans. turbofan/turbojet engines for fighters, atta	rmance, increased durability, reduced fuel consumption, and low, low pressure turbines, engine controls, exhaust nozzles, and intack aircraft, bombers, and transports. These components will pred fuel consumption, and lower life cycle cost.	egration technology) for	
- (U) \$2,861	Develop components for expendable engin	nes for missile and unmanned air vehicle applications. These coonsumption, and increased specific thrust, greatly expanding the		
– (U) \$2,216		prop and small turbofan engines for trainers, rotorcraft, special of	perations aircraft, and theater	
- (U) \$41,421	Total			
(T) ====================================	• .			
(U) <u>FY 2001 (\$ in The</u> - (U) \$29,754		ofan/turbojet engines for fighters, attack aircraft, bombers, and tr	ancharta Thaca components wil	
- (U) \$29,734		mance, increased durability, reduced fuel consumption, and low		
- (U) \$7,045	Develop turbine engine components (fans, turbofan/turbojet engines for fighters, atta	low pressure turbines, engine controls, exhaust nozzles, and intack aircraft, bombers, and transports. These components will pro-	egration technology) for	
- (U) \$2,897	Develop components for expendable engin	I fuel consumption, and lower life cycle cost. nes for missile and unmanned air vehicle applications. These consumption, and increased specific thrust, greatly expanding the		
- (U) \$2,359		prop and small turbofan engines for trainers, rotorcraft, special o	perations aircraft, and theater	
- (U) \$42,055	Total			

Project 3066

Page 9 of 12 Pages

Exhibit R-2A (PE 0602203F)

RDT&E BUDGET ITEM JUSTIFICATION	N SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsio	n PROJECT 3066
2 - Applied Research (U) B. Project Change Summary - Description of Significant Changes: Not A (U) C. Other Program Funding Summary (\$ in Thousands): (U) Related Activities: (U) PE 0602102F, Materials. (U) PE 0603202F, Aircraft Propulsion Subsystem Integration. (U) PE 0603216F, Aerospace Propulsion and Power Technology. (U) PE 0603210N, Aircraft Technology. (U) PE 0603210N, Aircraft Propulsion. (U) PE 0603003A, Aviation Advanced Technology. (U) This project has been coordinated through the Reliance process to I (U) D. Acquisition Strategy: Not Applicable.	Applicable.	n 3066
Project 3066 Page	e 10 of 12 Pages	Exhibit R-2A (PE 0602203F)

RDT&	E BUDGET ITE	EM JUS	TIFICAT	ION SH	IEET (R	-2A Exh	ibit)		DATE Fe	February 1999		
BUDGET ACTIVITY 2 - Applied Researc	2 - Applied Research						PE NUMBER AND TITLE 0602203F Aerospace Propulsion					
COST (\$ Ir	n Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost	
3145 Aerospace Power Techno	5 Aerospace Power Technology 14,060 18,741 12,176 15,516 21,194 23,892 24,389								24,792	Continuing	Continuing	
component and subsystem te supportability. This project suppower technologies are necessigeneration technologies develoutput power systems that are dual-use opportunities. Spin (U) FY 1998 (\$ in The - (U) \$12,047 - (U) \$1,505 - (U) \$508 - (U) \$14,060	supports an initiative was sary to meet the 10-20 sloped are enabling tech e suitable for application off application areas in	hich uses ele year long-te inologies for ons such as S aclude all mi meration, con ency, improve ort equipme rees for guide erations force perations force	ectrical powers all future managed passed litary system version, and red reliability ent requirement ance, navigues. Power strees with grees with grees.	er to replace requirements illitary direct Laser. Essent conversion transmission, maintainatents will be ation, and cources with eater reliabil	e hydraulic and sof Air Force ted energy (lentially, all pen development on component ability, and soft dramatically control function higher power lity and reduced to the soft of the sof	nd pneumati e uninhabite DE) weapon ower electro nt from conv ts for aircraf apportability reduced. ons for miss er density, lo	c power and d combat ae systems. The convergence of	their costly rial vehicles his project susion) techno electrically-but These compage a quicker a and for use it d increased in the costly the c	logistics sup (UCAVs). I apports deve logy being d based on-boa onents providircraft turn-a an navigation reliability wi	pport. These Electrical polopment of veveloped her rd subsystem de aircraft waround time.	electrical ower very high re has ns. ith a high In	
(U) <u>FY 1999 (\$ in The</u> - (U) \$16,153 - (U) \$1,738	ousands): Develop power generand supportability. Develop power source						_		-	-		
- (U) \$487 - (U) \$363 - (U) \$18,741	power density, longer costs. Develop special purpo Identified as a source Total	life, and incose power co	creased relia	bility will p	rovide specia	al operations	forces with	greater relia	bility and re	duced maint		
Project 3145				Page 11 of	f 12 Pages			Exhibi	t R-2A (PE	060220 <u>3</u> F)		

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit) DATE February 199							
BUDGET ACTIVITY 2 - Applied Resear	ch	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJEC 3145				
(U) Related Activitie - (U) PE 0603216	Develop power generation components for sufficiency, reliability, maintainability, at Develop advanced power electronics and Develop power and thermal management applications. Total **Cousands**): Develop power generation components for sufficiency, reliability, maintainability, at Develop advanced power electronics and Develop power and thermal management applications. Total **Counding Summary**: **Example Counding Summary*	energy storage components for aircraft, space, and directed energy por a system components to increase performance and reliability and reduce or aircraft and space systems. These components improve aircraft and and supportability. energy storage components for aircraft, space, and directed energy por a system components to increase performance and reliability and reduce the system components. Not Applicable.	ower systems. The weight in space power space systems self- ower systems.				

Page 12 of 12 Pages

Exhibit R-2A (PE 0602203F)

Project 3145